Pathways of staple crop productivity through agrobiodiversity to diet diversity:
Evidence on links and trade-offs

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DEFINITIONS AND SCOPE

- Agrobiodiversity is a permeable subset of biodiversity that cannot exist without us but that we have degraded throughout our history.
- Here, staple crop productivity refers only to grain yields of rice, maize, and wheat.
- We use household diet diversity as an indicator of food access.

We view the pathways of yield effects from the perspective of small-scale farm in a micro-agroecosystem with imperfect markets.
Hypothesis I: Raising staple crop productivity reduces agrobiodiversity

- Agrobiodiversity consists of multiple levels and spatial scales of analysis.
- Limited land → there is often an empirical trade-off between conserving a component of agrobiodiversity (varietal diversity) and productivity (a single highest yielding variety).
- Win-win options are feasible.

There is no clear evidence that raising yields of staple crops reduces agrobiodiversity; there is no clear evidence to the contrary.
Ia. Is staple crop productivity a major contributor to the expansion of agricultural land?

Yield change rather than area change explained most of production gains in rice, wheat and maize from 1961-2014.

Deforestation driven more by market forces for commodity crops and those with high income elasticity of demand (palm oil, meat).

Models with more complete counterfactuals show that the Green Revolution spared land and carbon dioxide.
Ib. Is there a relationship between staple crop productivity and diversity of crops grown?

Systematic evidence? Anecdotes and case studies report negative and positive linkages:

- Pingali describes concentration of area planted to input-responsive crops in India’s favored areas but less so in marginal areas.
- Dwivedi reports loss of legumes in India’s rice-wheat system.
- Singh confirms this point with data at two points in time in Haryana.
- Kurosaki finds specialization but also constant concentration of wheat area in Punjab (1902-1992).
- Reynolds and Duvick describe “the communal trait”

*Beyond our knowledge of the facts?*
Ic. Is there a relationship between staple crop productivity and genetic diversity of crops grown?

“Ancient patterns of diversity” replaced by modern varieties of staple crops

FAO’s Second State of the World: “no definitive statements” since 1996

CG studies: widening in genetic materials, at the molecular level

Meta-analysis finds narrowing in the 1960s, recovery to widening in the 1990s

On-farm research in eight countries shows diversity in traditional varieties

Variety age in farmers’ fields counteracts breeding progress
Hypothesis II. Raising the productivity of staple crops reduces dietary diversity

• In the aggregate, raising agricultural productivity is associated with better nutrition when incomes rise

• But how does this occur?

• Scant evidence that agricultural programs designed to enhance nutrition have been effective

• Are income changes from adoption of yield-increasing technology in staple food crops large enough?
IIa. Does raising on-farm diversity enhance diet diversity?

- Effect of on-farm diversity generally positive but small in magnitude
- Market effects may be greater
- Higher on-farm diversity may have positive impact on women’s dietary diversity
Lb. Does diversity of wild plants enhance diet diversity?

Generally yes, although the empirical evidence is sparse in terms of meeting nutritional adequacy.
Summary

No clear evidence that raising yields of staple crops reduces agrobiodiversity; no clear evidence to the contrary.

To the extent that staple food productivity encourages specialization on farms, it may affect diet diversity through lower on-farm agrobiodiversity, but market interventions appear to influence diet diversity in low income rural areas more than on-farm agrobiodiversity, especially as incomes rise.